

Module code

SPM-3407

Type of module

Undergraduate: Mathematical Sciences – Elective

Applied Mathematical Methods I



Modular credits

4

Total student
engagement

56 hours

Prerequisite

SPM-2205 (Ordinary
Differential Equations)
SPM-2206
(Multivariate Calculus)

Anti-requisite

None

Aims

To develop students' ability to apply advanced mathematical methods, including coordinate transformations, orthogonal functions, and differential equation techniques, to analyse and solve applied science and engineering problems.

Module learning outcomes (MLO)

On successful completion of this module, a student will be expected to be able to:

MLO 1

Apply coordinate transformations, tensor notation, and dyadic representations to derive and interpret gradient, divergence, curl, and Laplacian operators in orthogonal curvilinear coordinate systems.

MLO 2

Analyse invariant properties of tensors using basis and reciprocal basis vectors, Einstein summation notation, and the Levi-Civita tensor under coordinate transformations.

MLO 3

Construct and analyse orthogonal function expansions, including Fourier series and Sturm-Liouville eigenfunction expansions, with attention to orthogonality and convergence properties.

MLO 4

Apply analytical solution techniques for ordinary and partial differential equations, including power series methods, the method of Frobenius, and the method of characteristics.

MLO 5

Justify the selection of appropriate analytical methods when modelling applied science problems, recognising underlying assumptions and limitations.

Module contents

Orthogonal Curvilinear Coordinate System and Tensor: Coordinate transformation, invariant properties of tensors

Under coordinate transformation, Basis and reciprocal basis vectors, Dyadic representations

Einstein summation notation, Levi-Civita Tensor, Expressions for gradient, divergence, Laplacian and curl of a vector in an orthogonal curvilinear coordinate system

Orthogonal Functions: Expansion of functions in orthonormal functions, Fourier series, full range and half range sine and cosine series, convergence

Sturm-Liouville Problems: Characteristic values and characteristic functions. Basic theorem, orthogonality of characteristic functions

Ordinary Differential Equations: Solution in power series, method of Frobenius, Legendre differential equation, Introduction to Legendre and Bessel functions and some important properties

First Order Partial Differential Equations: Characteristic curves. Solution of initial value problems by the method of characteristics

Assessment

60%

Examination

40%

Coursework

Examination
60%

Class tests
40%

■ Examination — 60% ■ Class tests — 40%

Formative assessment	Summative assessment	
Weekly discussion and feedback	COMPONENT	WEIGHTING
	Examination	60%
	Coursework	40%
	Individual	40%
	Class tests	40%

Graduate attributes and skills

Programme learning objectives (PLO) addressed

1	PLO 1 (Core Mathematical Knowledge)	2	PLO 2 (Analytical Problem-Solving)
3	PLO 3 (Computational and Digital Tools)	4	PLO 4 (Mathematical Communication)
6	PLO 6 (Adaptability and Lifelong Learning)		

Sustainability concept addressed

4	SDG 4 Quality Education
9	SDG 9 Industry, Innovation and Infrastructure

Digital skills/software used (not limited to)

■	Learning management and collaboration platforms (e.g. Canvas, Microsoft Teams)
■	Mathematical and computational software (e.g. Mathematica, MATLAB)
■	Spreadsheet and numerical analysis software (e.g. Microsoft Excel)
■	Word processing software (e.g. Microsoft Word)

Micro-credentialling option No	Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes No
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Document details

Office	ODVCE	Document date	26 June 2026	Status	New	Approval	GBF (12/02/2026)
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